

# The mortality assumption

Social Security Advisory Board's Technical Panel

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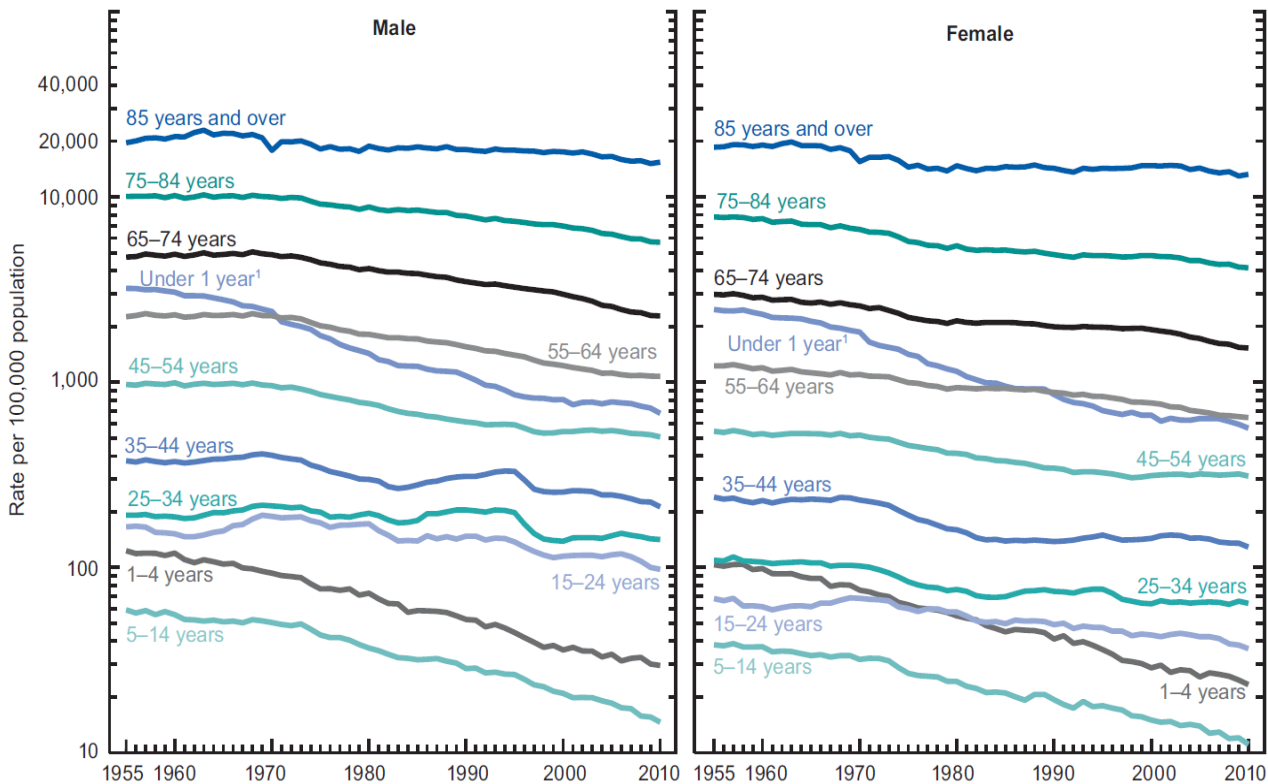
# 1. From starting point to ultimate

- Current approach
  - Take the weighted average change by age group and gender over the last 12 available years, regressing from there to ultimate assumptions in 25 years
  - For 2014 Trustees Report, NCHS data (through 2010) until age 65 and Medicare data (through 2011) for after age 65
- Overall approach and the 25 year time period to ultimate are reasonable
- Separately, there is no sound (agreed upon) basis for developing explicit assumptions for very long periods in the future (e.g., greater than 75 years)

## 2. By cause method

- By-cause modeling has been controversial
  - Those opposed believe
    - Complex; future mortality not known in sufficient detail to estimate this level of detail; causes are not independent and extent of dependency unknown; questionable cause-of-death data especially due to multiple causes and at older ages; and cause categories with low assumed improvement rate will dominate, thus biasing improvement rates downward
    - Some believe linear extrapolation of historical patterns most likely
  - Those in favor believe
    - Statistical projections are naïve and overly-simplistic; period chosen to derive overall averages is arbitrary; reliance on older periods not relevant to the future, with average of never-to-be-repeated historical improvements assumed to continue, resulting in unreasonable long-term projections
  - Both believe each other's assumptions are overly subjective, opaque and complex
- Suggested recommendation
  - Both approaches are useful
    - The question is which should serve as the base projections and which should be a consideration
  - Recent OACT simplification offsets concerns to some extent

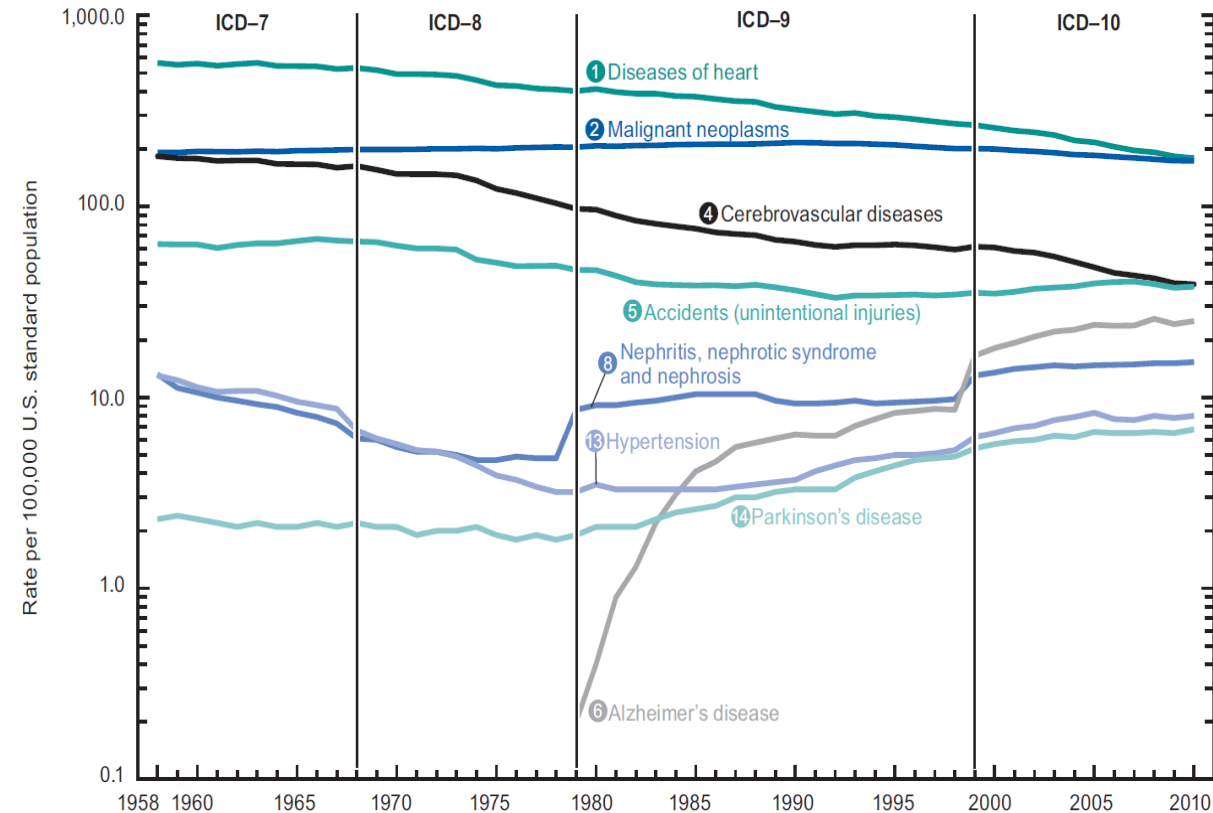
# U.S. Mortality — source *Deaths: Final Data for 2010*



<sup>1</sup>Rates are based on population estimates, which differ from infant mortality rates (based on live births); see Figure 7 for infant mortality rates and Technical Notes for further discussion of the difference.

NOTE: Rates for 2001–2009 are revised using updated intercensal population estimates and may differ from rates previously published; see Technical Notes.

SOURCE: CDC/NCHS, National Vital Statistics System, Mortality.



NOTES: ICD is the *International Classification of Diseases*. Circled numbers indicate ranking of conditions as leading causes of death in 2010. Rates for 2001–2009 are revised using updated intercensal estimates and may differ from rates previously published; see Technical Notes.

SOURCE: CDC/NCHS, National Vital Statistics System, Mortality.

### 3. Aggregate improvement and age

- Current Trustees' annual multiplicative improvement factors decrease by attained age
- Historical average rates of improvement (from OACT) – several ways of grouping:

Ages	1900-2010	1982-2010
15-64	1.33%	1.32%
65+	0.78	0.79

Ages	Males		Females		Alt 2
	1979-2000	2000-2010	1979-2000	2000-2010	2038-2088
15-49	1.0%	1.2%	0.5%	0.6%	0.9%
50-64	2.0	1.2	1.0	1.5	1.1
65-84	1.1	2.4	0.1	1.8	0.7
85+	- 0.5	1.6	- 0.6	1.3	0.5

### 3. Aggregate improvement and age

- Recent Tech Panel recommendations
  - 2011 – life expectancy at birth rather than improvement rates; equivalent to rate of annual improvement of 1.26%
  - 2007 – a rate of improvement of 1.0% for all ages
  - 2003 – an age gradient (after 10 years from projection) of 1.11% for adult ages through age 75, grading to 0% at age 122.5
- CBO (December 2014) used 1.17% annual improvement rate for all ages and genders (corresponding to average rate for 1950-2008 period)
- Other countries' social security projections
  - Canada assumes a significant annual reduction by attained age in ultimate period, ranging from 0.8% through age 84, reducing to 0.2% from age 95 (applied to more favorable mortality level in Canada than the U.S.)
  - U.K. does not assume an age gradient, with annual improvement of 1.2%, plus a cohort adjustment for favorable cohorts

## 4. Gender

- Overall, mortality improvement was faster for females through about 1980 and faster for males thereafter
  - Turnaround was due in part to larger percentage reduction in smoking prevalence from a higher prevalence rate (and consequential reduction in mortality) for males
- The percentage improvement for females should begin speeding up as later reduction in smoking is incorporated in mortality rates
- Trustees assume ultimate rates of improvement by gender will be the same
- Suggested recommendation
  - Agree with Trustees that rates of improvement by gender be equivalent in the ultimate period



## 5. Benefit amount

- Better mortality for those with higher retirement benefit amounts has been reflected (post-entitlement factor) by increasing average benefit over time for each retirement cohort
  - Based on past ten year average increase (average of about 0.45% annually, decreasing by year since retirement)
  - Likely to continue
- Suggested recommendation
  - Continue reflection of differential mortality effect on benefit size
  - Review whether there is a trend in this differential, at least over the next 25 years

## 6. Cohort

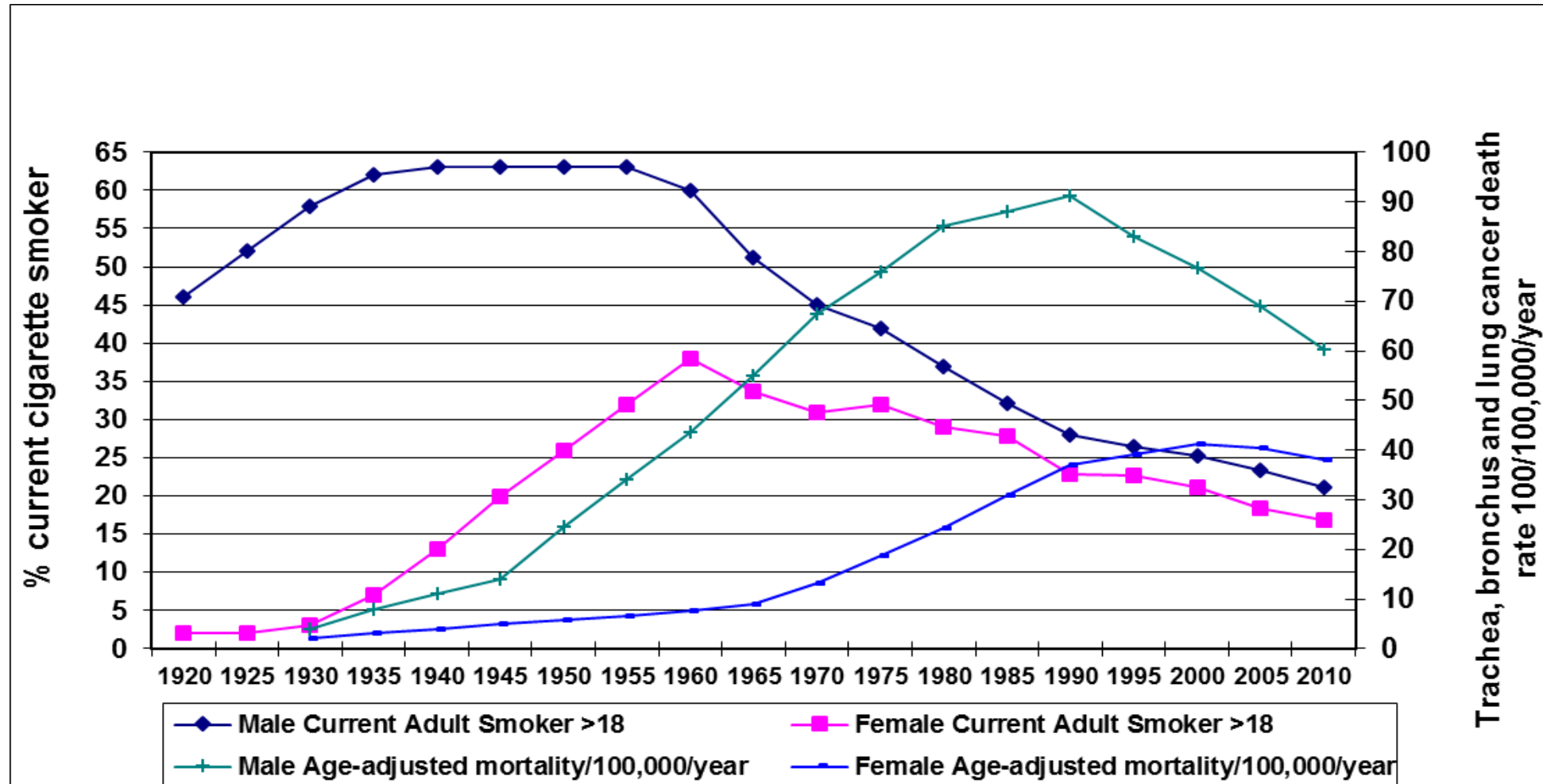
- Currently mortality rates and improvement factors do not differ by year of birth cohort
- Some evidence that cohort may become significant in the future, at least over the short-term
  - Society of Actuaries' new Pension mortality table (MP-2014), Ryan et al (2014)\* -- indicate both period and cohort influences
  - However, difficult to predict in advance
- Suggested recommendation
  - Conduct research into cohort-related adjustments
    - Historical experience to date at very older ages reflect generations at lower educational/standard of living level than succeeding generations, suggesting larger future improvement at older ages
    - Generations subsequent to the Baby Boomers may not experience as favorable rates

\*Ryan, Hummer, Powers, Beck, Lin, Finch, "Long-term trends in adult mortality for U.S. blacks and whites: an examination of period- and cohort-based changes". *Demography* (2014) 51:2047-73.

## 7. Cardiovascular disease

- Tremendous improvements have occurred over the last 50 years, helped by improved risk factor treatment and medications and smoking reductions
- Although improvements are likely to continue (expansion in use of statins, ...), there may be a limit reached, especially since other than smoking, further new advances may be more difficult to achieve
- Suggested recommendation
  - Reductions assumed by Trustees for ages 50+ are not unreasonable

## 8. Smoking – prevalence and mortality

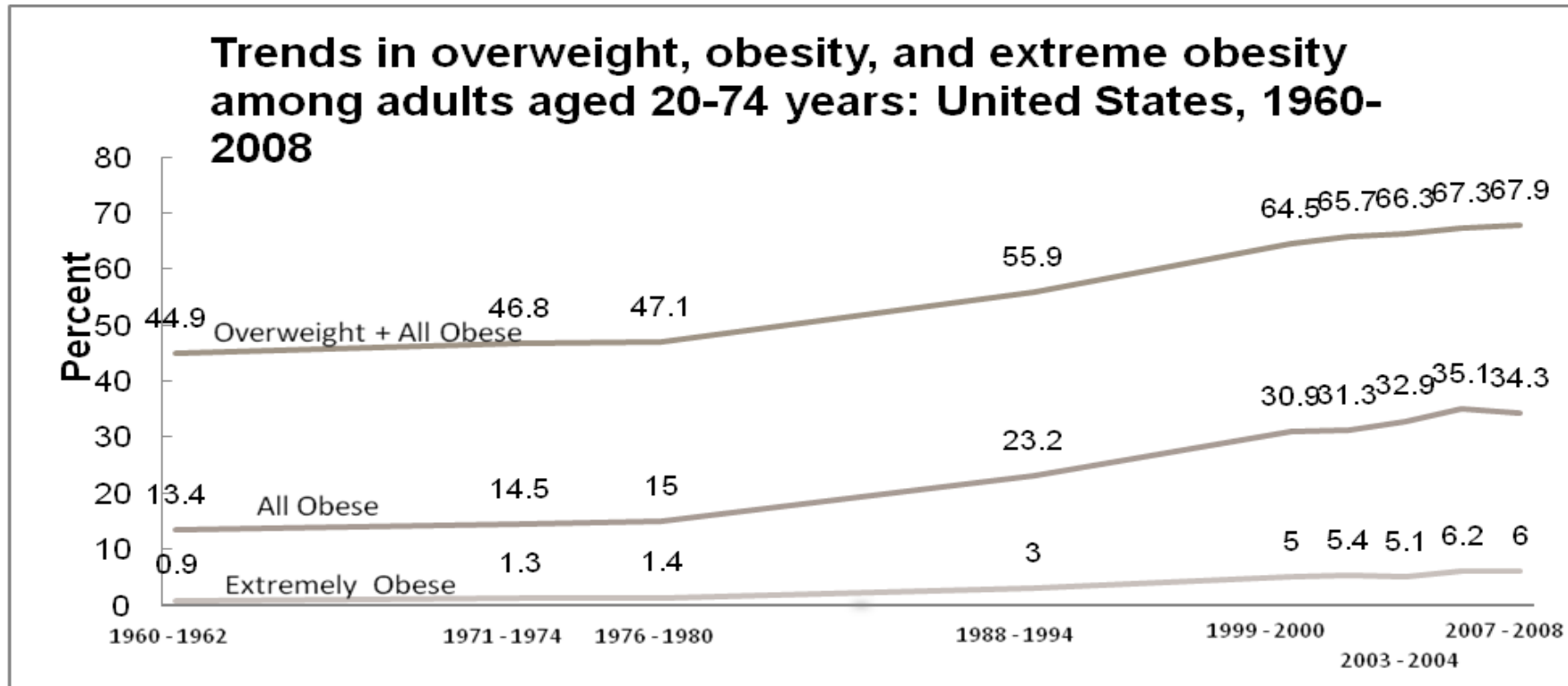


Source: Gutterman(2014); age-adjusted mortality rate due to smoking has recently been between 4 and 5 times the rate for lung cancer

## 8. Smoking

- Significant effect, has contributed to greater improvement in male mortality due to larger and earlier reduction in smoking prevalence over the last two decades, with improvements relating to female smoking just beginning
- Consequential improvement should continue to be greater for males than for females over the next decade, ultimately being similar by gender
- Suggested recommendation
  - In ultimate years (after major impact of smoking cessation diminishes), lower rates of mortality improvement, converging by gender

## 9. Obesity – prevalence rates



National Health and Nutrition Surveys

## 9. Obesity

- Although obesity prevalence has significantly increased over the last 40 years (and morbidly obese prevalence has increased faster lately), so far the additional mortality has not been overly significant, especially at older ages
- However, longer-term effects after a long exposure to excess adiposity tissues of those recently obese may become adverse
- Suggested recommendation
  - Ultimate mortality assumption may be affected adversely, with more likely impact on those at lower wage levels

# 10. Expert opinions

- Medical / epidemiological experts
  - Historical projections have traditionally been conservative, i.e., mortality improvement has been understated
    - Because almost all of unexpected developments have been favorable
    - Uncertainty relates to whether these favorable unknowns will continue to emerge
- Example of expert opinion–based projections is the recent (unpublished yet) survey of Johns Hopkins’ medical professionals (covering the next 25 years)
  - Assessed medical-related causes that historically provided most mortality improvement
  - Factors likely to have a significant favorable impact
    - Reduction in smoking (all but violent causes), development of treatments such as immunotherapies (cancer), improvements in auto safety (violent causes)
  - Factor likely to have a significant adverse impact
    - Climate change (respiratory)
  - For next 25 years, aggregate projections of JH experts are consistent with current Trustees’ projections, with significant age improvement gradient for each major cause of death / gender



# 11. Soneji and King 2012 *Demography* paper

- Projected significantly greater mortality improvement than SSA
- Criticizes SSA projections because
  - Discontinuity of projected mortality rates by individual age
    - Inherent in the use of discrete factors for age groups
  - Overly complex model
    - Has since been simplified by OACT (fewer causes of death and same ultimate gender improvement projections)
  - Cause of death assumptions highly subjective, with no reflection of inter-dependence of causes
    - A challenge in any projection method, especially because little is known of susceptibility to other causes of those who previously would have died due to other causes
- I have not been able to replicate S&K's projections, as I have seen sufficient detail and have not located software indicated in their paper
  - Paper indicates their projections are based on “a time trend and cohort smoking and obesity prevalence lagged by 25 years”
  - Insufficient information in paper provided to form an opinion

# 12. Uncertainty

- 2011 Tech Panel, because of wide range of possible course of future mortality recommended a very wide of improvements ( $\pm 10$  years of life expectancy at birth)
  - Although uncertainty is large, this wide range does not provide decision-useful information
- Possible asymmetry of mortality improvement projections
  - More currently known favorable possibilities (e.g., medical and genetic treatments, faster cigarette smoking cessation) than unfavorable factors
  - Higher likelihood of improved (rather than worse) mortality relative to an Alt 2 assumption

# Overall recommendations

- Mortality projections will always be uncertain, so a relatively wide range of results is reasonable, but cannot be too large to make projections decision-useless
- No conceptual basis has been identified to assume mortality improvement will be independent of age, so an age-gradient is recommended
- (very tentative) Overall agreement with Trustees assumptions, but with somewhat larger ultimate improvement rate at older ages
- Somewhat higher rate of improvement for high cost projections